

OBSERVATIONS ON THE PREY AND NESTS OF SEVEN SPECIES OF *CERCERIS* (HYMENOPTERA: SPHECIDAE)¹

Howard E. Evans² and William L. Rubink²

ABSTRACT.—*Cerceris* species are remarkably constant in their prey preferences. Records are presented from diverse localities that confirm prey constancy in five species. An apparent exception is noted in the case of *C. crotonella* Viereck & Cockerell. A mixed aggregation of *C. fumipennis* Say and *C. californica* Cresson is reported, both preying upon Buprestidae and using some of the same species. Nest and prey of *C. conifrons* Mickel are reported for the first time.

One of the striking features of the behavior of species of *Cerceris* is their prey constancy. Even in widely disparate parts of the range, females of a given species tend to utilize beetles of only one family, often of only a few related genera. Such specialization doubtless reduces competition among species nesting together. Evans (1971) reported three species nesting together at Bedford, Massachusetts, each preying upon quite a different kind of weevil; later (1974) he added still a fourth species from this same site, utilizing still a different kind of weevil. Despite their prey specificity, the species of *Cerceris* are remarkably similar in many aspects of their nesting behavior.

In this paper we report still further examples of prey constancy in diverse parts of the ranges of five species. We also report an apparent exception in the case of one species, *C. crotonella* Viereck & Cockerell. Further, we report a mixed aggregation of two closely related species, *C. fumipennis* Say and *C. californica* Cresson, both preying upon Buprestidae, including several of the same species. The first records of the nest and prey of *C. conifrons* Mickel are presented, as well as diverse notes on the nests of other species.

Cerceris simplex macrosticta Viereck & Cockerell

On 20 July 1976, we took a female of this large species flying with her prey over

an arroyo 30 km NE of Lordsburg, New Mexico. The prey proved to be a tenebrionid beetle, *Pechalius subvittatus* Casey. On 24 and 31 August 1976, we studied an aggregation of some 40 females of this species about 9 km N of Roggen, Weld Co., Colorado. At this site a single species of Tenebrionidae was being employed as prey, *Bothrotes plumbeus plumbeus* (LeConte) (N=38, with several additional sight records and several additional records from the same area in 1977). Since Alcock (1974, 1975) has published two excellent papers on *C. simplex macrosticta*, we present only a few notes here. The prey at Alcock's site in Arizona also consisted of a single species of Tenebrionidae, in this case *Metapoloba pruinosa* (Horn) (N=60, with additional sight records). It is interesting that these three genera, *Metapoloba*, *Bothrotes*, and *Pechalius*, all belong to the tribe Epitragini. Lin (1967) studied *C. simplex graphica* Smith in Oklahoma and found the prey there to consist of a single tenebrionid species, *Eleodes opaca* (Say), a member of a different subfamily. Since the ranges of these two subspecies of *simplex* appear to overlap broadly, thought might be given to the possibility of their being separate species.

At the Roggen site, nests were located in a steep slope of fine-grained sand, mostly devoid of vegetation, where the chief associates were species of *Bembix*, *Microbembex*, and at least two species of bees. *Cerceris*

¹Research supported by the National Science Foundation, grant BNS76-09319.

²Department of Zoology and Entomology, Colorado State University, Fort Collins, Colorado 80523.

nests were situated over a distance of some 30–40 m along the bank, but they were definitely clumped in certain places, along with those of the bees. In these clumps nest entrances were often no more than 5–15 cm apart, but the clumps themselves were separated by several meters. Nest entrances were left open while the females were provisioning, and each was surrounded by a rim of sand, as is usual in this genus. A male *macrosticta* was taken on flowers of *Croton texensis* (Klotzsch) not far away, but no males were seen in the nesting area.

During the morning hours, females were frequently seen descending to their nests holding beetles in their mandibles in such a way that they hung down obliquely from the body. They were frequently followed by 1–3 satellite flies, *Senotainia* sp., and when so followed the wasps would often circle widely before entering their nests, making loops several meters in diameter at different heights and occasionally landing on vegetation. One female spent six minutes making an evasive flight of this nature, then finally entered the nest without any flies following her. Only 1 of the 12 cells eventually excavated appeared to have had the contents destroyed by maggots, so we judge that the wasps are often successful in evading satellite flies.

Nest structure agreed closely with that figured by Alcock (1974) for this species. One of the two nests we excavated had five cells, the other seven. Cells varied in depth from 17 to 32 cm ($\bar{x}=26$, precisely the same figure Alcock obtained in Arizona). In both cases beetles had been stored at various points in the burrow, chiefly near its terminus. The number of beetles per cell was two in one case, three in nine cases, and seven in one case. Most cells measured 10 x 12 mm, but the one containing seven beetles measured 14 x 23 mm. We suspect this was a "female producing cell", the others "male" cells, a situation that is probably common if not universal in *Cerceris*. These figures are also very similar to those obtained by Alcock in Arizona.

Cerceris bicornuta Guérin

This is a relatively well-studied species,

and we present only a few notes confirming prey constancy in diverse parts of the range. On 23 July 1975 we took a female *C. bicornuta bicornuta* 14 km W of Laporte, Colorado, carrying a weevil, *Sphenophorus cicatristriatus* Fähræus in her mandibles. She landed on a dirt road, apparently en route to her nest, and rested there for a moment with her wings extended obliquely above her abdomen.

During the month of July 1976 we observed an aggregation of *C. bicornuta fidelis* Viereck & Cockerell at the LaJoya Wildlife Preserve, 30 km N of Socorro, New Mexico. On 1 July we counted 44 nests in an area 3 x 5 m in flat, hard-packed sandy loam beside a dirt road. About an equal number of *Tachytes aurulentus* (F.) also nested here, and the nests of the two species were somewhat intermingled and rather similar in external appearance, both having a large mound at the entrance and the hole near the center of the mound. However, the *Tachytes* were most active in the early morning, as early as 0630, while the *Cerceris* provisioned their nests over the warm part of the day. The *Cerceris* nests were well spaced, mostly 0.3–1.0 m apart, but some were very close to *Tachytes* nests (in one case only 15 cm from a *Tachytes* nest).

Provisioning females entered the area 1–2 m high and plunged directly into the open nest entrances. Prey was carried in the mandibles as usual in the genus, and consisted of a single species of weevil, *Sphenophorus australis* Chittenden (N=12). Weevils were stored in the burrow, as usual in this genus. We dug out only one nest in 1976, early in the season and apparently before any cells had been made. The nest had a mound at the entrance measuring 15 x 17 cm, 2.5 cm high, with the burrow penetrating the center. Burrow diameter was 8 mm. This burrow was vertical for 29 cm, then leveled off abruptly and extended another 27 cm before terminating blindly. Three weevils were found about midway in the horizontal part of the burrow.

In July 1977, we made further observations on this same aggregation, though many fewer nests were visible. Three nests were excavated. The first, on 8 July, yielded five weevil prey from the single, recently

completed cell. Two species, *Sphenophorus neomexicanus* Chittenden (N=4) and *S. cistristriatus* Fähræus (N=1) were represented. A second nest, excavated on 12 July, contained no cells and a single weevil, *S. cistristriatus*, midway down the 25 cm long burrow. The third nest, examined on 27 July, yielded more substantial information on nest structure. However, because of several days of inactivity due to heavy rain, none of the cell contents were suitable for preservation. Seven cells contained from three to seven weevils each, as determined from the prey remains. All cells measured approximately 15 x 30 mm. Two cells, at depths of 11 and 18 cm, contained only intact, decomposing weevil remains. Two others, 13 and 16 cm deep, contained cocoons and remains of weevils. A cell at a depth of 29 cm contained a dipteran larva that died shortly after removal. The two remaining cells, at depths of 24 and 31 cm, contained *Cerceris* larvae 12 and 21 cm long, respectively. Cells were widely spaced, 7-15 cm apart.

Krombein (1960) studied *C. bicornuta fidelis* in Arizona, where the wasps were also making deep nests along the edge of a road. The prey here consisted of the weevil *Eupagoderes* sp., which he found to be common on the flowers of snakeweed. There are several papers dealing with the biology of *C. bicornuta bicornuta* in diverse parts of its range, e.g. Rau (1928), Cartwright (1929), Strandtmann (1945), and Krombein (1953). Scullen and Wold (1969) summarize prey records from five different states (New York, Ohio, Missouri, North and South Carolina), in every case a single genus of weevil, *Sphenophorus*. Evans (1971) added additional records for this genus of weevil from Connecticut, based on unpublished records of Richard Dow.

Cerceris crotonella Viereck & Cockerell

This small species is a common inhabitant of extensive areas of fine-grained sand in Colorado and New Mexico. We have seen prey-laden females carrying small beetles into open holes in sand on several occasions, but we have had no success in finding cells. On 5 July 1975 we captured a female with

prey 4 km S of Caddoa, Bent Co., Colorado. The beetle proved to be *Pachybrachys minor* Bowditch (Chrysomelidae). This is in contrast to a record from western Texas of this species preying upon a beetle of the unrelated family Nitidulidae (Evans 1971). Clearly this species will bear further study.

Cerceris conifrons Mickel

This is a small species bearing much resemblance to *crotonella* and belonging to the same species-group (group I of Scullen 1965). On 11 August 1977 a female was seen plunging into an open, oblique burrow along a path at Great Sand Dunes National Monument, Alamosa Co., Colorado. The nest was in fine-grained but rather firm sand in a small open space among low grasses and forbs. There was no mound of soil at the entrance. The female was captured as she left the nest at 1300 hours, and the nest was excavated. The burrow formed about a 30-degree angle with the surface for 17 cm, then went down vertically for another 5 cm, terminating at a vertical depth of 12 cm. There were five very small weevils at the bottom of the burrow, *Epi-mechus* sp. (Curculionidae). It is probable that these had merely been stored in the bottom of the burrow and that no cell had yet been prepared.

Cerceris echo Mickel

This species resembles the preceding two in size and color and is a member of the same species-group. Records from widely separate parts of the range demonstrate that this species is a specialist on beetles of the family Phalacridae. Evans (1971) reported beetles of this family as prey of *C. echo atrata* Scullen in Lexington, Massachusetts, and as prey of *C. echo echo* Mickel in Cornish, Utah. On 15 August 1977, at the LaJoya State Wildlife Preserve, 30 km N of Socorro, New Mexico, we captured a female *C. echo echo* as she was hovering above her nest with prey. The nest was located in a small bare depression in fine aeolian sand among scattered *Dalea*, *Atriplex*, and bunch grasses, and below the active sand dunes. No tumulus was apparent

around the nest entrance. The burrow proceeded vertically 40 cm through very dry, loose soil, then angled sharply, continuing downward at a 30 degree angle with the horizontal, terminating at a depth of 44 cm. Three beetles were found at the angle in the burrow. Two small cells were found at depths of 54 and 62 cm, but no eggs or larvae were visible. These cells contained 19 and 28 prey, respectively. On 1 September, a second nest was found in the same area and excavated. The soil was moist, as a result of recent rains, and the nest was shallower. Although it was not possible to follow the main burrow, a cache of 4 beetles was found at a depth of 24 cm and a cell containing 17 beetles was found at a depth of 27 cm. All the prey in both nests belonged to one of two species of Phalacridae, *Phalacrus* sp. (N=23) and *Olibrus* sp. (N=3). Male *C. echo echo* were also common in the area of the nest site and were frequently seen entering burrows, presumably in search of females.

Cerceris fumipennis Say and
C. californica Cresson

These are both among the best-studied species of this genus, *fumipennis* being mainly an eastern species, ranging west to Wyoming and New Mexico, *californica* a common western species ranging east to Utah and Texas. There are many prey records for both species, summarized by Scullen and Wold (1969); both use a wide variety of Buprestidae. These are related wasps, both belonging to group II of Scullen (1965). It was with considerable interest that we found the two nesting together 11-12 June 1976 at Monahans Sandhills State Park, Ward Co., Texas. About six nests of *C. californica californica* were intermingled with about 30 nests of *C. fumipennis* in slightly sloping soil along the edge of a paved road. The soil was a rather firm, coarse sand containing many small stones; it had apparently been brought from another area into this region of sand dunes to serve as a base for the road. *Hoplisoides splendidulus* (Bradley) was also nesting close beside the two species of *Cerceris* (Rubink 1977).

Females of both species brought in prey

at frequent intervals during the day, carrying the beetles in their mandibles and plunging into open nest entrances. Nests of *C. californica* had the entrance mounds only on one side of the hole, those of *fumipennis* surrounding the hole; otherwise there was no difference in external appearance. Nor was there any noteworthy difference in nest structure. We excavated 3 nests of *californica*. In each case the mound at the entrance measured about 4 x 5 cm, about 1 cm high. The burrow penetrated the soil obliquely or nearly vertically, terminating at a depth of only 8-12 cm, and containing 7-32 beetles in storage near the bottom. One nest had only one cell, the other two five cells each, the cells varying in depth from 7 to 13.5 cm ($\bar{x}=10$). The number of beetles per cell varied from 7 fairly large ones to 31 very small ones. The two nests of *fumipennis* we excavated were of virtually identical structure. Both had an oblique burrow reaching a depth of 8-9 cm and containing beetles in storage at the terminus. One nest had only one cell, the other 11. Cells varied in depth from 7 to 15 cm ($\bar{x}=10.2$). The number of beetles per cell varied from 15 to 16 (N=3; most of the cells had cocoons and only fragments of beetles).

We refrain from further discussion of nesting behavior since both species have been well studied elsewhere, *californica* by Linsley and MacSwain (1956), *fumipennis* by Evans (1971) and several others (references in Scullen and Wold 1969). However, we were especially interested in discovering to what extent females of the two species were competing for prey. Several species of Buprestidae appeared in the nests of both species (Table I). In general, *fumipennis* females took beetles of medium size (5.5-10.5 mm in length). Females of *californica* also took beetles of this same size, but 41 percent of the prey consisted of a minute buprestid, *Acmaeodera quadrivittata* Horn, not utilized by *fumipennis*. However, four other species appeared in the nests of both species.

On several occasions satellite flies, *Senotainia* sp., probably *rubriventris* Macquart, were seen following females carrying prey. Numerous male mutillids flew close above

the ground in the morning hours. A number of females were also seen, some of them attempting to enter nests of *C. fumipennis*, though usually being repelled by the resident wasp. The mutillids proved to be males and females of *Dasymutilla snoworum* Cockerell and Fox. We have no definite information that this species is a parasite of *Cerceris*, but the species was common in the nesting area and was not noted elsewhere.

ACKNOWLEDGMENTS

We are indebted to the following specialists for identifying the beetle prey: W. F. Barr(Buprestidae), J. M. Kingsolver (Phalacridae), T. J. Spilman (Tenebrionidae), R. White (Chrysomelidae), and D. R. Whitehead (Curculionidae). R. J. Gagné identified the miltogrammine flies.

LITERATURE CITED

ALCOCK, J. 1974. The nesting behaviour of *Cerceris simplex macrosticta* (Hymenoptera: Sphecidae). *J. Nat. Hist.* 8: 645-652.
 ———. 1975. Social interactions in the solitary wasp *Cerceris simplex* (Hymenoptera: Sphecidae). *Behaviour* 54: 142-152.
 CARTWRIGHT, O. L. 1929. The maize billbug in South Carolina (*Calendra maidis* Chittn.). *Bull. So.*

Carolina Agri. Exp. Sta. no. 257: 31 pp.
 EVANS, H. E. 1971. Observations on the nesting behavior of wasps of the tribe Cercerini. *J. Kansas Ent. Soc.* 44: 500-523.
 ———. 1974. Digger wasps as colonizers of new habitat (Hymenoptera: Aculeata). *J. N.Y. Ent. Soc.* 82: 259-267.
 KROMBEIN, K. V. 1953. Kill Devil Hills wasps, 1952 (Hymenoptera: Aculeata). *Proc. Ent. Soc. Wash.* 55: 113-135.
 ———. 1960. Biological notes on several southwestern groundnesting wasps (Hymenoptera: Sphecidae). *Bull. Brooklyn Ent. Soc.* 55: 75-79.
 LIN, C. S. 1967. Bionomics of *Cerceris simplex graphica* at Lake Texoma (Hymenoptera: Sphecidae: Phylanthinae). *Proc. Ent. Soc. Wash.* 69: 312-317.
 LINSLEY, E. G. AND J. W. MACSWAIN. 1956. Some observations on the nesting habits and prey of *Cerceris californica* Cresson (Hymenoptera: Sphecidae). *Ann. Ent. Soc. Amer.* 49: 71-84.
 RAU, P. 1928. Field studies in the behavior of the non-social wasps. *Trans. Acad. Sci. St. Louis* 25: 319-489.
 RUBINK, W. L. 1977. Nesting behavior and prey records of *Hoplisoides splendidulus* (Bradley). *Southwestern Ent.* 2: 1-3.
 SCULLEN, H. A. 1965. A review of the genus *Cerceris* in America north of Mexico (Hymenoptera: Sphecidae). *Proc. U.S. Natl. Mus.* 116: 333-547.
 SCULLEN, H. A., AND J. L. WOLD. 1969. Biology of wasps of the tribe Cercerini, with a list of Coleoptera used as prey. *Ann. Ent. Soc. Amer.* 62: 209-214.
 STRANDTMANN, R. W. 1945. Observations on the nesting habits of some digger wasps. *Ann. Ent. Soc. Amer.* 38: 305-313.

TABLE 1. Prey records for *Cerceris fumipennis* and *C. californica*, Monahans, Texas.

Beetle species	Mean length x width (mm)	Wasp species		Total
		<i>fumipennis</i>	<i>californica</i>	
<i>Acmaeodera quadrivittata</i> Horn	6.3	0	51	51
<i>Acmaeodera variegata</i> Leconte	20.3	50	58	108
<i>Agrilus pulchellus</i> Bland	20.7	11	14	25
<i>Chrysobothris</i> (two species)	38.0	1	2	3
Total		62	125	187